Microtechnology in Telecommunication for Spacecraft Cost and Mass Reduction

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A factor of two in mass reduction over conventional deep space telecommunication spacecraft hardware architect ures is a challenge which we have undertaken for the Pluto Fast Flyby Advanced Technology Initiative (A'] I). B y helping to lower spacecraft mass, we can reduce launch vehicle size and significantly save in launch costs. Also by increasing our data rate for science, we can reduce mission operation costs.

We arc meeting our goals by employing slate-of- the-arl technology which can bc quickly and economically qualified for flight readiness. Based on this premise wc have identified areas in which competi tive contracts were awarded to industry to demonstrate. a low-mass dual frequenc y X/Ka-Band antenna, an X-Band digital receiver, and a high efficiency Ka-Band (32. GHz) solid state power amplifier (SSPA) output module.

The I ligh Gain Antenna for the Pluto Fast-Flyby Spacecraft was original] y designated to bc a flight spate 1.47 m Viking antenna. This unit incorporated an S-X band feed providing an X-band gain of 39 dBic. The ATI breadboard effort engaged the task of reducing the Viking antenna mass of 5.9 Kg while, maintaining or surpassing the RF performance. The Boeing Company, whose proposal was selected for the ATI program, will provide a 1.5 m reflector fitted with a dual band feed (X-Ka of similar design to the Viking antenna) at a projected mass of 2.,5 Kg. This reflector consists of twelve aluminum honeycomb ribs joining a circumferential honeycomb ring reinforcing the back side of the reflector shell. The shell is a 2.5mm thick graphite / cyanate ester. The rc.suiting structure, which embodies a new hybridization between a semi-nmmcoquc, and all-honeycomb design, is very stiff and light enabling the more than 40 % decrease in mass.

A Ka-Band 1.SW SSPA unit has the potential of increasing our data rate by at least a factor of two; thereby, allowing greater science return and reducing mission operations cost. The Martin Marietta corporation, whose proposal was selected for the ATI program, will develop an output module with at least 1.5W RF power with 5 dB gait) at 25% power added efficiency. The key to achieving this goal is the usc of advanced Pseudomorphic I ligh Electron Mobility Transistor (PHEMT) technology. Currently, there is only 10W of prime power available. By achieving and surpassing our goal, we can reduce prime power power consumption; thereb y, increasing data rate and at the same time reducing RTG mass.

The most significant mass savings is in the development of an X-Band digital receiver. This component absorbs the Command Detector Unit (CDU) function and is a substantial part of the transponder (which is composed of a receiver and exciter). TRW, whose proposal was selected for the ATI program, will develop this reciever with a goal of <1 kg and power consumption less than 4 .5W. The key to achieving this ambitious goal is the utilization of monolithic microwave integrated circuit (MMIC), ASIC and multichip module (MCM) packaging technologies. A complete transponder, CDU, and telemetry control unit whose current single string mass is 6.3 kg can bc reduced by over 6(J% using the. technologies just described.

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